

# **AROE User Manual**

(Automation of **R**NA **O**ptimization for **E**xpression)

Version 1.0

Last modified 14 December 2007 by Alex Lee

## Table of Contents

<b>List of Figures .....</b>	<b>3</b>
<b>1 Introduction .....</b>	<b>4</b>
1.1 URL.....	4
<b>2 Function list .....</b>	<b>5</b>
2.1 Administration .....	6
2.1.1 Request of registration.....	6
2.1.2 Approval of registration .....	7
2.1.3 Logging on to the system .....	8
2.1.4 Logging out from the system.....	8
2.1.5 Changing user information .....	9
2.1.6 Changing configuration file.....	10
2.1.7 Monitoring ongoing jobs .....	11
2.2 RNA structure scoring .....	12
2.3 Construct optimization for expression .....	15
2.3.1 Optimization analysis .....	15
2.3.2 Optimization results.....	17
2.4 An AROE session time out .....	20

## List of Figures

Figure 1: Registration for new users .....	6
Figure 2: Approval of registration.....	7
Figure 3: Login.....	8
Figure 4: Changing user information .....	9
Figure 5: Changing configuration file .....	10
Figure 6: Monitoring ongoing jobs .....	11
Figure 7: RNA structure scoring .....	13
Figure 8: RNA structure scoring result .....	14
Figure 9: Optimization analysis .....	16
Figure 10: Optimization analysis reply .....	16
Figure 11: List of request for optimization .....	17
Figure 12: Result of job finished normally.....	18
Figure 13: Result of ongoing job.....	19
Figure 14: Result of job finished abnormally.....	20

## 1 Introduction

The AROE (Automation of RNA Optimization for Expression) web server provides alternative designs for a given RNA or DNA sequence. RNA secondary structure is predicted using the Vienna RNA package (<http://tbi.univie.ac.at/~ivo/RNA/>). RNA structure optimization attempts to free interested motifs (such as AUG and SD sequence) from complicated secondary structures.

### 1.1 URL

Users can navigate the AROE web server by accessing <http://catorhpc100:8080/>.

## 2 Function list

The AROE web server provides the following functions:

- Administration
  - Registration
  - User Login
  - Changing user information
  - Changing configuration file
  - Monitoring ongoing jobs
- RNA structure scoring
- Constructing optimization for expression

## 2.1 Administration

### 2.1.1 Request of registration

To navigate AROE web, user should register first.

- Click register on Login page.
- Type all information.
- The length of ID must be 4.

**A . R . O . E**  
Automation of RNA Optimization for Expression

**sanofi pasteur**  
The vaccines business of sanofi-aventis Group

Score Optimization Search My Info Login Help

ID:  \* (Length is 4)  
Password:  \* (Length is up to 20)  
First Name:  \*  
Last Name:  \*  
Phone:  \*

Register Clear


Email: [Joe.Wang@sanofipasteur.com](mailto:Joe.Wang@sanofipasteur.com) Tel: (416)667-2700 ext:3275

**Figure 1: Registration for new users**

### 2.1.2 Approval of registration

Only administrators can access this menu.

- Log in to AROE with administrator account.
- Click *Approval* on menu.
- Check checkbox for approving registration.
- Click *Grant* button.
- Checked users will disappear.



The screenshot shows the AROE web application interface. At the top, the AROE logo is displayed with the text 'Automation of RNA Optimization for Expression'. To the right is the Sanofi Pasteur logo with the tagline 'The vaccines business of sanofi-aventis Group'. Below the logos is a navigation bar with the username 'aroewebm' and several menu items: 'Approval', 'Configuration', 'Monitoring', 'My Info', 'Logout', and 'Help'. The 'Approval' menu is selected. Below the navigation bar, the heading 'List of users waiting for approval' is shown. A table lists the users, with columns for 'All', 'UserId', 'First Name', 'Last Name', 'Phone', and 'Email'. One user is listed: 'test' with first name 'test', last name 'aroe', phone '1111', and email 'test.aroe@sanofipasteur.com'. A checkbox is present next to the 'test' user. Below the table is a 'Grant' button. At the bottom of the page, contact information is provided: 'Email: Joe.Wang@sanofipasteur.com' and 'Tel: (416)667-2700 ext:3275'.

All	UserId	First Name	Last Name	Phone	Email
<input type="checkbox"/>	test	test	aroe	1111	test.aroe@sanofipasteur.com

Grant

Email: [Joe.Wang@sanofipasteur.com](mailto:Joe.Wang@sanofipasteur.com) Tel: (416)667-2700 ext:3275

**Figure 2: Approval of registration**

### 2.1.3 Logging on to the system

An AROE session must be initiated by logging into the system. When presented with the screen below, type in your credentials (that you have been approved by an administrator).

- Type ID and Password.
- Click *Login*.

The screenshot displays the AROE (Automation of RNA Optimization for Expression) login page. At the top, the AROE logo is on the left, and the Sanofi Pasteur logo with the tagline 'The vaccines business of sanofi-aventis Group' is on the right. Below the logos is a navigation bar with a '[demo]' link and buttons for 'Score', 'Optimization', 'Search', 'My Info', 'Logout', and 'Help'. The central part of the page features a login form with an 'ID:' label and a text box containing 'demo', a 'Password:' label and a masked text box, and three buttons: 'Login', 'Reset', and a 'register' link. At the bottom, a blue footer bar contains the contact details: 'Email: Joe.Wang@sanofipasteur.com' and 'Tel: (416)667-2700 ext:3275'.

**Figure 3: Login**

### 2.1.4 Logging out from the system

An AROE session will be terminated by logging out.

- Click *Logout* on menu.



### 2.1.5 Changing user information

This function enables a user to change his/her information.

- Click *MyInfo* on menu.
- Change information as needed.
- Type current password.
- To change password, type current password and new password.

The screenshot shows the A.R.O.E. (Automation of RNA Optimization for Expression) web application interface. The header includes the A.R.O.E. logo and the Sanofi Pasteur logo with the tagline 'The vaccines business of sanofi-aventis Group'. A navigation bar contains links for 'demo', 'Score', 'Optimization', 'Search', 'My Info', 'Logout', and 'Help'. The main content area displays a form for updating user information. The form fields are: ID (demo), First Name (aroe), Last Name (0000), Password (empty), New Password (empty), and Phone (1111). An 'Update' button is located below the phone number field. The footer displays the email 'Email: Joe.Wang@sanofipasteur.com' and the telephone number 'Tel: (416)667-2700 ext:3275'.

demo   Score   Optimization   Search   My Info   Logout   Help

ID: demo

First Name: aroe

Last Name: 0000

Password:   \* New Password

Phone: 1111

Update

Email: [Joe.Wang@sanofipasteur.com](mailto:Joe.Wang@sanofipasteur.com)   Tel: (416)667-2700 ext:3275

**Figure 4: Changing user information**

### 2.1.6 Changing configuration file

Only administrators can access this menu.

- Log in to AROE with administrator account.
- Click *Configuration* on menu.
- Change original value of a key to desired new value.
- Click *Reload* button in order to read original configuration file again.
- Click *Update* button in order to adapt new value.

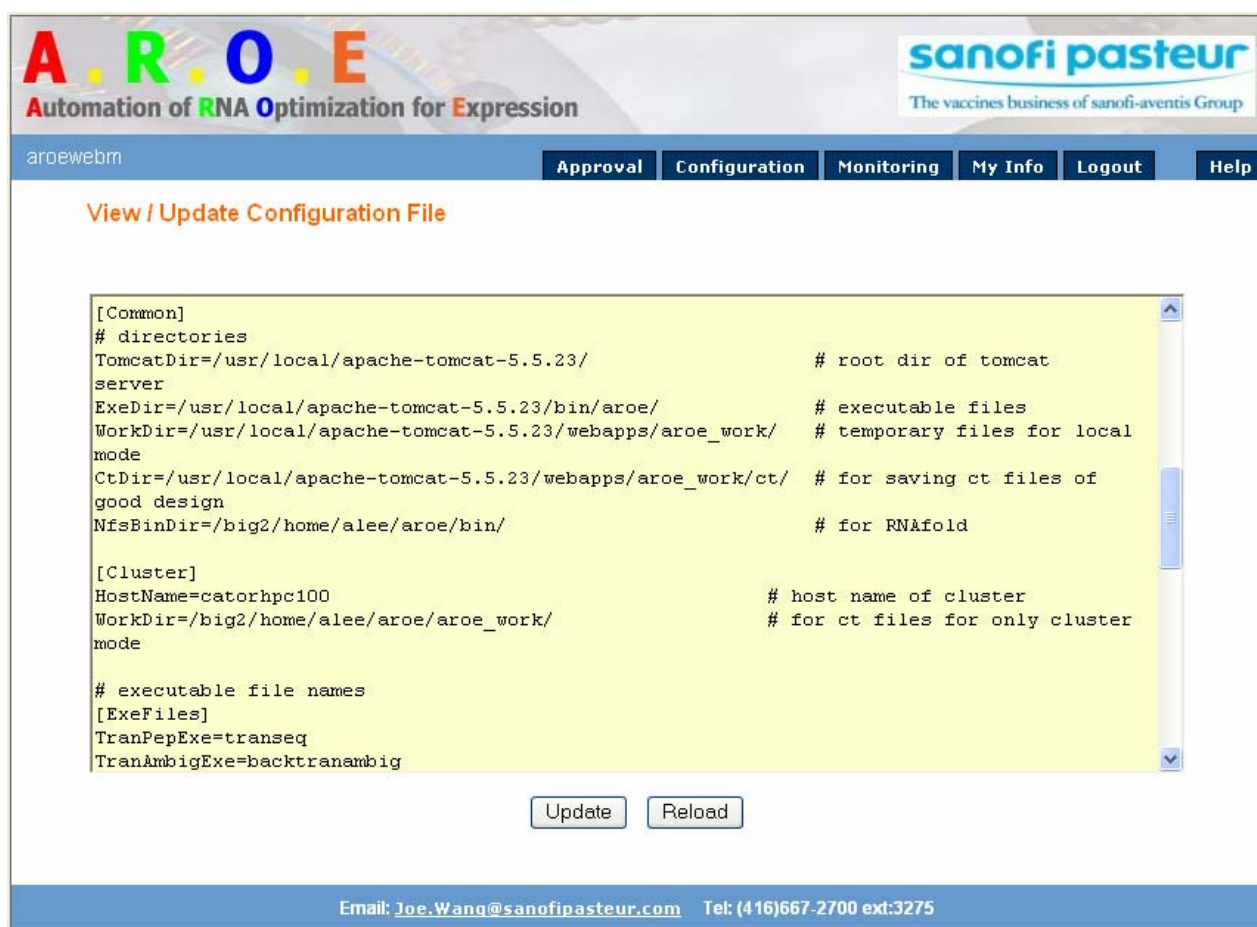


Figure 5: Changing configuration file

### 2.1.7 Monitoring ongoing jobs

Only administrators can access this menu.

- Log in to AROE with administrator account.
- Click *Monitoring* on menu.
- Click *Terminate* link in order to terminate a job.
  - Click *OK* button to commit to terminating the job.

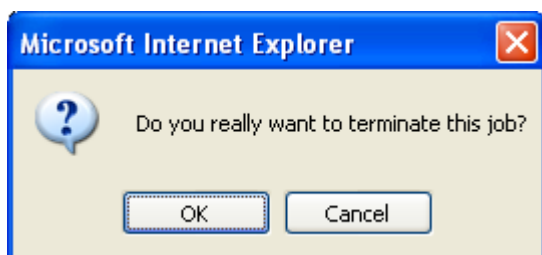


The screenshot shows the AROE web interface. The header includes the AROE logo and the Sanofi Pasteur logo. The navigation bar has tabs for Approval, Configuration, Monitoring, My Info, Logout, and Help. The main content area is titled "Processing job list" and contains a table with the following data:

Userid	Sequence name	Start time	Cut-off score	Highest score	Terminate
demo	ter-4	2007-10-24 14:56:33	20,80	10,100	<a href="#">Terminate</a>
demo	ter-32	2007-10-25 09:10:16	20,80	10,100	<a href="#">Terminate</a>
demo	ad-1	2007-10-25 15:22:50	20,80	10,100	<a href="#">Terminate</a>
1111	user1111-1	2007-10-25 15:24:17	20,80	10,100	<a href="#">Terminate</a>

The footer of the interface displays the email address [Joe.Wang@sanofipasteur.com](mailto:Joe.Wang@sanofipasteur.com) and the telephone number (416)667-2700 ext:3275.

**Figure 6: Monitoring ongoing jobs**



## 2.2 RNA structure scoring

This function enables a user to see how good the secondary structure of RNA is, for given motif(s).

- Click *Score* on menu.
- Paste RNA or DNA sequence in the text box.
  - White space will be removed.
  - The length of a given sequence is limited up to 7000.
- Type position of motifs.
  - Format: 10-12,20-25,etc.
  - Note: 10 is start position and 12 is end position. If there is more than two, use a comma as separator.
- Change temperature if default value is not desired.
- Select RNAfold parameters.
- Click *Run*.
- Click *What is score?* link to learn how the score is calculated.

**A . R . O . E**  
Automation of RNA Optimization for Expression

**sanofi pasteur**  
The vaccines business of sanofi-aventis Group

demo

ScoreOptimizationSearchMy InfoLogoutHelp

**Predict score for particular motif(s) of sequence**[What is score?](#)

DNA Sequence: (Size: )

TACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCCGCCGGTGCCGGTGAGCAAAAGTGGTGAGCACCGATGAATATGTG  
GCGCGTACCAACATTATTATCATGCGGGCACCAGCCGTCTGCTGGCCGTGGGCCATCCGTATTTCCGATCAAAAAACCGAACAA  
CAAAATTCTGGTGCCGAAAGTGAGCGGCTGCAGTATCGTGTGTTTCGTATTTCATCTGCCGGATCCGAACAAATTGGCTTTCCGGATA  
CCAGCTTTTATAATCCGGATACCCAGCGTCTGGTGTGGCGTGCGTGGGTGTGGAAGTGGGTCTGTGCCAGCCGCTGGGCGTGGGCATT  
AGCGGTCATCCGCTGCTGAACAACTGGATGATACCGAAAACGCG

\*

Positions of motif:  \*(i. e. 20-23,109-113)  (Indicate motif with '[' and ']')

RNAfold parameters:

Rescale energy parameters to temperature  C \*

☐ nospecial tetraloops

☒ no dangling end energies

☐ no GU pairs at the end of helices

Email: [Joe.Wang@sanofipasteur.com](mailto:Joe.Wang@sanofipasteur.com) Tel: (416)667-2700 ext:3275

Figure 7: RNA structure scoring

### Figure 8: RNA structure scoring result

## 2.3 Construct optimization for expression

### 2.3.1 Optimization analysis

This function recommends to the user with optimized RNA structure.

- Click *Optimization* on menu.
- Type sequence name.
- Paste RNA or DNA sequence.
  - Note: White space will be removed automatically.
- Type position of start codon.
  - Format: 10-12
  - Note: 10 is the start position and 12 is the end position.
- Type position of motifs.
  - Format: 10-12,20-25,etc.
  - Note: 10 is the start position and 12 is the end position. If there are more than two motifs, use a comma as separator.
- Type cut-off score
  - Format: 80,90
  - The number of motifs and the number of cut-off scores should be same.
  - Note: 80 is cut-off score for the first motif and 90 is cut-off score for the second motif. If there are more than two cut-off scores, use a comma as separator.
- Change temperature if default value is not desired.
- Select RNAfold parameters.
- Select report options.
  - Best design will return the first design that meets better than the cut-off score. It is not an exhaust search for the best design among all possible design.
  - Top 5 designs will return the first five designs that meet better than the cut-off score.
- Click *Run*.
- The result of request comes out depending on the length of sequence and cut-off score. User can look up the result in the *Search* menu later.

**A . R . O . E**  
Automation of RNA Optimization for Expression

sanofi pasteur  
The vaccines business of sanofi-aventis Group

demo Score Optimization Search My Info Logout Help

**Optimize sequence** [What is score?](#)

Name of sequence: demo-prj1 \*

DNA Sequence: (Size: 490)

```
TATACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCCGCCGGTGCCGGTGAGCAAAAGTGGTGAGCACCAGATGAATA
TGTGGCGCGTACCAACATTATTATCATGCGGGCACCAGCCGTCTGCTGGCCGTGGGCCATCCGTATTTCCGATCAAAAAACCGAA
CAACAACAAAATTCTGGTGCCGAAAAGTGAGCGGCCTGCAGTATCGTGTGTTTCGTATTTCATCTGCCGGATCCGAACAAAATTTGGCTT
TCCGGATACCAGCTTTTATAATCCGATACCCAGCGTCTGGTGTGGCGTGCGTGGGTGTGGAAGTGGGTCGTGGCCAGCCGCTGGG
CGTGGGCATTAGCGGTCATCCGCTGCTGAACAAACTGGATGATACCGAAAACGCG
```

Position of start codon: 77-79 \* (i.e. 45-47)  (Indicate start codon with '[' and ']')

Positions of motif: 48-52,77-79 \* (i.e. 20-23,109-113)  (Indicate motif with '[' and ']')

Cut-off score: 70,80 \* (Range: 0 - 100, i.e. 80,90)

**RNAfold parameters:**

Rescale energy parameters to temperature 37 C \*

☐ nospecial tetraloops

☒ no dangling end energies

☐ no GU pairs at the end of helices

**Report type:**

☒ Best design with fasta format sequence

☐ Top 5 designs with fasta format sequence

Email: [Joe.Wang@sanofipasteur.com](mailto:Joe.Wang@sanofipasteur.com) Tel: (416)667-2700 ext:3275

Figure 9: Optimization analysis

**A . R . O . E**  
Automation of RNA Optimization for Expression

sanofi pasteur  
The vaccines business of sanofi-aventis Group

demo Score Optimization Search My Info Logout Help

**Result for your request**

Your request is sent to queue.  
You can check the result of your request on Search menu later.

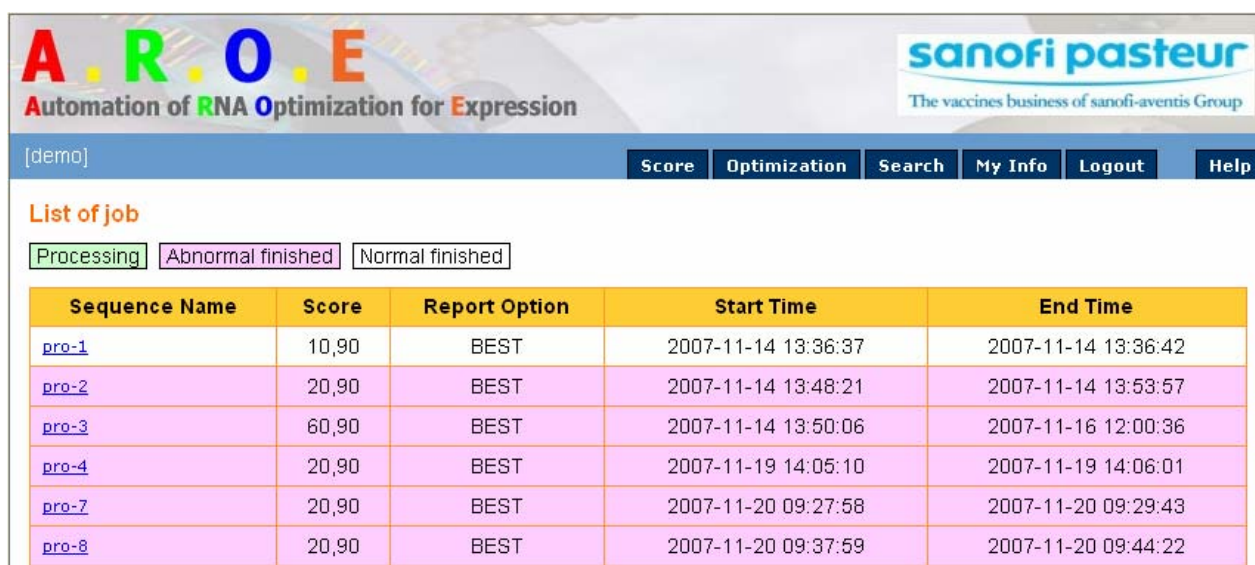
Figure 10: Optimization analysis reply



### 2.3.2 Optimization results

This function enables users to view the results of sequence optimization.

- Click *Search* on menu.
- To see detail information, click a sequence name.
- There are three different status for jobs.
  - Normally finished job coloured white.
  - Abnormally finished job coloured pink.
  - Ongoing job coloured green.



The screenshot shows the A.R.O.E. (Automation of RNA Optimization for Expression) web application. The header includes the logo and the Sanofi Pasteur tagline. A navigation bar contains links for Score, Optimization, Search, My Info, Logout, and Help. Below the navigation bar, there is a 'List of job' section with three filter buttons: 'Processing' (highlighted in green), 'Abnormal finished' (highlighted in pink), and 'Normal finished' (white). A table displays the list of jobs with columns for Sequence Name, Score, Report Option, Start Time, and End Time. The table contains six rows of data, all with a 'BEST' report option.


Sequence Name	Score	Report Option	Start Time	End Time
<a href="#">pro-1</a>	10,90	BEST	2007-11-14 13:36:37	2007-11-14 13:36:42
<a href="#">pro-2</a>	20,90	BEST	2007-11-14 13:48:21	2007-11-14 13:53:57
<a href="#">pro-3</a>	60,90	BEST	2007-11-14 13:50:06	2007-11-16 12:00:36
<a href="#">pro-4</a>	20,90	BEST	2007-11-19 14:05:10	2007-11-19 14:06:01
<a href="#">pro-7</a>	20,90	BEST	2007-11-20 09:27:58	2007-11-20 09:29:43
<a href="#">pro-8</a>	20,90	BEST	2007-11-20 09:37:59	2007-11-20 09:44:22

**Figure 11: List of request for optimization**

- Click sequence name in white row to see the result of a job finished normally.
- Yellow bases are specified motifs.
- Red bases are changed ones.

# A . R . O . E

**Automation of RNA Optimization for Expression**



The vaccines business of sanofi-aventis Group

demo

Score Optimization Search My Info Logout Help


Detail information of job finished normally

<b>Sequence Name</b>	ter-1
<b>DNA Sequence</b>	CGAAATTAATACGACTCACTATAGGGGAATTGTGAGCGGATAACAAT <b>TCCCT</b> CTAGAAATAATTTGTT TAACTT <b>T</b> AGAAAGGAGATATACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCCGCCGG TGCCGGTGAGCAAAAGTGGTGAGCACCAGATGAATATGTGGCGGTACCAACATTATTATCATGCCGGCAC CAGCCGTCTGTGGCGTGGGCCATCCGTATTTCCGATCAAAAAACCGAACAACAACAAATTTCTGGTG CCGAAAGTGAGCGGCTGCAGTATCGTGTGTTTCGTATTCATCTGCCGATCCGAACAAATTTGGCTTTC CGGATACCAGCTTTTATAATCCGGATACCCAGCGTCTGGTGTGGCGTGCCTGGGTGTGGAAGTGGGTCG TGGCCAGCCGCTGGCGTGGGCATTAGCGGTCATCCGCTGCTGAACAACTGGATGATACCGAAAAACGCG
<b>Protein Sequence</b>	EGDIHMSLWLPSEATVYLPVPVSKVSTDEYVARTNIYYHAGTSRLAVGHPYFPIKKPNNKILVPKV SGLQYRVFRIHLPDPNKFGEFPTSFYNPDTQRLVWACVGVEVGRGQPLGVGISGHPLLNKLDDENA
<b>Startcodon position</b>	77-79
<b>Motif(s)</b>	48-52,77-79
<b>Cut-off Score</b>	10,80
<b>Design 1</b> <b>Score: 10,100</b> <a href="#" style="color: #e67e22;">CT File</a>	CGAAATTAATACGACTCACTATAGGGGAATTGTGAGCGGATAACAAT <b>TCCCT</b> CTAGAAATAATTTGTT TAACTT <b>T</b> AGAAAGGAGATATACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCCGCCGG TGCCGGTGAGCAAAAGTGGTGAGCACCAGATGAATATGTGGCGGTACCAACATTATTATCATGCCGGCAC CAGCCGTCTGTGGCGTGGGCCATCCGTATTTCCGATCAAAAAACCGAACAACAACAAATTTCTGGTG CCGAAAGTGAGCGGCTGCAGTATCGTGTGTTTCGTATTCATCTGCCGATCCGAACAAATTTGGCTTTC CGGATACCAGCTTTTATAATCCGGATACCCAGCGTCTGGTGTGGCGTGCCTGGGTGTGGAAGTGGGTCG TGGCCAGCCGCTGGCGTGGGCATTAGCGGTCATCCGCTGCTGAACAACTGGATGATACCGAAAAACGCG


**Figure 12: Result of job finished normally**

- Click *CT File* link to see .ct file for selected design in result screen of the job finished normally.

- Click sequence name in green row to see the result of an ongoing job.
- Click *Terminate* link to terminate a job in the result screen of ongoing job.



**Automation of RNA Optimization for Expression**



The vaccines business of sanofi-aventis Group

demo

Score
Optimization
Search
My Info
Logout
Help

Detail information of on-going job status

<b>Sequence Name</b>	ter-4
<b>DNA Sequence</b>	CGAAATTAATACGACTCACTATAGGGGAATTGTGAGCGGATAACAAT <b>TCCCC</b> TCTAGAAATAATTTTGT TAACTTT <b>TA</b> GAAGGAGATATACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCGCCGG TGCCGGTGAGCAAAAGTGGTGAGCACCGATGAATATGTGGCGGTACCAACATTATTATCATGCGGGCAC CAGCCGTCTGCTGGCCGTGGGCATCCGTATTTTCCGATCAAAAAACCGAACAAACAAAAATTTCTGGTG CCGAAAGTGAGCGGCTGCAGTATCGTGTGTTTCGTATTTCATCTGCCGGATCCGAACAAATTTGGCTTTC CGGATACCGAGCTTTTATAATCCGGATACCCAGCGTCTGGTGTGGGCGTGCCTGGGTGTGGAAGTGGGTCG TGGCCAGCCGCTGGGCGTGGGCATTAGCGGTCATCCGCTGCTGAACAAACTGGATGATACCGAAAAACGCG
<b>Startcodon position</b>	77-79
<b>Motif(s)</b>	48-52,77-79
<b>Cut-off Score</b>	20,80
<b>Highest Score</b>	10,100
<b>Design</b>	CGAAATTAATACGACTCACTATAGGGGAATTGTGAGCGGATAACAAT <b>TCCCC</b> TCTAGAAATAATTTTGT TAACTTT <b>TA</b> GAAGGAGATATACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCGCCGG TGCCGGTGAGCAAAAGTGGTGAGCACCGATGAATATGTGGCGGTACCAACATTATTATCATGCGGGCAC CAGCCGTCTGCTGGCCGTGGGCATCCGTATTTTCCGATCAAAAAACCGAACAAACAAAAATTTCTGGTG CCGAAAGTGAGCGGCTGCAGTATCGTGTGTTTCGTATTTCATCTGCCGGATCCGAACAAATTTGGCTTTC CGGATACCGAGCTTTTATAATCCGGATACCCAGCGTCTGGTGTGGGCGTGCCTGGGTGTGGAAGTGGGTCG TGGCCAGCCGCTGGGCGTGGGCATTAGCGGTCATCCGCTGCTGAACAAACTGGATGATACCGAAAAACGCG
<b>Evaluated Number</b>	16480
<b>Start Time</b>	2007-10-24 14:56:33
<b>Last Update Time</b>	2007-10-24 16:07:17.0
<b>Terminate job</b>	<a href="#">Terminate</a>

**Figure 13: Result of ongoing job**

- Click sequence name in pink row to see the result of a job finished anormally.

A . R . O . E

**Automation of RNA Optimization for Expression**

The vaccines business of sanofi-aventis Group

demo

Score
Optimization
Search
My Info
Logout
Help

Detail information of job finished abnormally

<b>Sequence Name</b>	ter-1
<b>DNA Sequence</b>	CGAAATTAATACGACTCACTATAGGGGAATTGTGAGCGGATAACAATTCCCCCTCTAGAAATAATTTTGT TAACTTTAAGAAGGAGATATACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCCGCCGG TGCCGGTGAGCAAAAGTGGTGAGCACCAGATGAATATGTGGCGCGTACCAACATTATTATCATGCCGGGCAC CAGCCGCTCTGCTGGCCGTGGGCCATCCGTATTTTCCGATCAAAAAACCGAACAAACAAAAATTCTGGTG CCGAAAGTGAGCGGCTGCAGTATCGTGTGTTTCGTATTTCATCTGCCGGATCCGAACAAATTTGGCTTTC CGGATACCAGCTTTTATAATCCGGATACCCAGCGTCTGGTGTGGCGGTGCGTGGGTGTGGAAGTGGGTG TGCCAGCCGCTGGCGTGGGCATTAGCGGTCATCCGCTGCTGAACAAACTGGATGATACCGAAAAACGCG
<b>Startcodon position</b>	77-79
<b>Motif(s)</b>	48-52,77-79
<b>Cut-off Score</b>	20,80
<b>Highest Score</b>	10,100
<b>Design</b>	CGAAATTAATACGACTCACTATAGGGGAATTGTGAGCGGATAACAATTCCCCCTCTAGAAATAATTTTGT TAACTTTAAGAAGGAGATATACATATGAGTCTGTGGCTGCCGAGCGAAGCGACCGTTTATCTGCCGCCGG TGCCGGTGAGCAAAAGTGGTGAGCACCAGATGAATATGTGGCGCGTACCAACATTATTATCATGCCGGGCAC CAGCCGCTCTGCTGGCCGTGGGCCATCCGTATTTTCCGATCAAAAAACCGAACAAACAAAAATTCTGGTG CCGAAAGTGAGCGGCTGCAGTATCGTGTGTTTCGTATTTCATCTGCCGGATCCGAACAAATTTGGCTTTC CGGATACCAGCTTTTATAATCCGGATACCCAGCGTCTGGTGTGGCGGTGCGTGGGTGTGGAAGTGGGTG TGCCAGCCGCTGGCGTGGGCATTAGCGGTCATCCGCTGCTGAACAAACTGGATGATACCGAAAAACGCG
<b>Evaluated Number</b>	230

**Figure 14: Result of job finished abnormally**

## 2.4 An AROE session time out

- If a user does nothing for 30 minutes, the session will disappear.
- If a user clicks *Logout* on menu, the session will disappear right away.